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HEARINGS

Before The

SUBCOMMITTEE ON WATER QUALITY

COMMITTEE ON PUBLIC WORKS

UNITED STATES SENATE

*Report Waste Treatment
& Pollution*

AIR AND WATER POLLUTION

Washington, D. C.

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AIR AND WATER POLLUTION

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MONDAY, JULY 26, 1971

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United States Senate,

Subcommittee on Water Quality
of the Committee on Public
Works,

Washington, D. C.

The subcommittee met at 11 a.m., pursuant to notice,
in room 4110, New Senate Office Building, Hon. Thomas F.
Eagleton, presiding.

Present: Senators Eagleton, Tunney, and Boggs.

Staff members present: M. Barry Meyer, Chief Clerk and
Staff Director; Thomas C. Jorling, Minority Counsel; Leon G.
Billings, Professional Staff Member; Bailey Guard, Minority
Staff Member; Jim Jordan, Minority Staff Member; and Hal
Brayman.

Senator Eagleton. On the record.

Good morning, Senator Boggs, and others.

We do not, as of this moment, have a quorum, continuing
our mark-up process on the water bill, but I think we can use
this time to good educational advantage.

We have with us this morning Professor John Sheaffer,
on leave of absence from the University of Chicago, doing some
consulting work for the Secretary of the Army and, more

specifically, the Corps of Engineers. He is accompanied by Mr. Jim Tozzi, of the Corps of Engineers.

I think Professor Sheaffer can tell us about a project or a development that has gone on at Muskegon, Michigan, a city of about 150,000, and also somewhat similar experience at Penn State University.

STATEMENT OF DR. JOHN SHEAFFER, UNIVERSITY OF CHICAGO,
CONSULTANT TO THE SECRETARY OF THE ARMY, ACCOMPANIED BY:
JIM TOZZI, CORPS OF ENGINEERS

Mr. Sheaffer. That is considerably smaller, about 30,000.

Senator Eagleton. Since it relates to regional treatment of waste, et cetera, that which we will discuss treats of that subject, it is really germane to where we are in the bill today.

Mr. Meyer. May I interrupt just a second?

Senator Eagleton. Surely.

Mr. Meyer. The study Professor Sheaffer has been engaged in is as a result of authority contained in Rivers and Harbors Act directing that five or six regional waste treatment operations be investigated and we are getting what amounts to a preview of the recommendations which will come forward to the Secretary.

Senator Boggs. I don't want to delay, but just so we get in the right framework and understand the same thing, what is our concept of a regional area that you are talking

1 about? You will describe that, won't you?

2 Mr. Shaffer. Yes, sir.

3 Senator Eagleton. Also not to delay, but to put it in
4 a better, more accurate, context, we will have either Leon or
5 Barry describe briefly, if they can do it briefly, what is
6 in the present draft of the committee print on this general
7 subject matter and we can maybe try to relate that more
8 specifically to what the Professor suggests.

9 Mr. Billings. There are two sections of the bill which
10 specifically relate to this discussion. One is Section 209,
11 which provides for the designation of waste management
12 regions and requires the development of basically metropolitan
13 area region-wide waste management systems and waste management
14 plans.

15 The second section is the provision for new source
16 performance standards for industry which require where
17 technically feasible the application of the no discharge
18 requirement.

19 The regional waste management program is intended to
20 encourage the integration of all waste sources within a
21 designated region and into one system. This would complement
22 the new source performance standards because under this proposal
23 once a regional system existed an industry would be able to
24 connect to it and would for all practical purposes have achieved
25 the no discharge standard.

1 Now, the application of a development of technology
2 for regional waste management systems is the subject which
3 I understand Dr. Sheaffer is prepared to discuss.

4 Senator Eagleton. What is the no discharge standard,
5 what does that actually mean as drafted in the print?

6 Mr. Billings. It is vague, but the intent would be,
7 in essence, to require an industry to put back water of a quality
8 they took out.

9 Senator Eagleton. Professor, the floor is yours.

10 Mr. Sheaffer. Perhaps to best understand the technology
11 and where it is now, I think we could take a minute or two
12 to explain why there was an attempt to develop a new approach
13 or a new system, I should say, that would be helpful.

14 Muskegon County, Michigan, is about 150, 160 thousand
15 people, but it is a highly industrialized area so you have
16 a waste flow of about 44 million gallons a day. So you would
17 expect a population of closer to a half million with that
18 waste flow.

19 Perhaps I could illustrate here on the board because it is
20 typical of most cities. It has a number of water bodies like
21 this. These are lakes. This is Lake Michigan. It had quite
22 a few sewage treatment plants, about seven of them, to be
23 exact, and these lakes became very degraded.

24 Incidentally, this treatment plant is one of the best
25 secondary treatment plants in Michigan. So, in other words,

1 they were giving a reasonable degree of treatment. Some of
2 these were owned by industry, some by municipalities. These
3 bodies of water became very degraded and, obviously, affected
4 the area of Lake Michigan, all of these, to the rivers flowing
5 into these.

6 Senator Eagleton. Those seven plants up there were other
7 little municipal plants?

8 Mr. Sheaffer. They are all municipal plants, municipal
9 or industries owned the plants.

10 The question was how do you improve these plants to
11 meet the Lake Michigan conference proceedings which said that
12 they should give the equivalent of secondary treatment and
13 remove 80 percent of the phosphates. This is what everybody
14 was ordered to do.

15 The public officials there became quite concerned when
16 upon close questioning of the engineers who were designing
17 these systems it was concluded in public hearings that the
18 water quality of these lakes would not really improve. In other
19 words, if they took the 34 and expanded the treatment processes
20 and took the 80 percent phosphate removal that the best they
21 could be guaranteed was that the quality of the water would
22 not get any worse. In other words, we may hold the line.
23 But the officials became quite concerned because they already
24 recognized that water is a problem.

25 Senator Boggs. Was the water at this stage accommodating

1 wild fish?

2 Mr. Sheaffer. That becomes kind of a vague sort of
3 thing. There are fish in there, there are Coho salmon
4 that swim through although they have been designated as kind
5 of tastingly. You can't see through six inches of the
6 water. In fact, that is what one of the public officials said.

7 Senator Boggs. The health people don't allow people to
8 swim in it?

9 Mr. Sheaffer. That is right, they recommend you not
10 swim in it.

11 Senator Boggs. Thank you.

12 Mr. Sheaffer. Now, the point made, then, was somepeople
13 from Muskegon County contacted me and they asked me is there
14 a better route to go; in other words, could we do something
15 other than expanding these treatment plants and removing the
16 phosphates and in fact improve the environment.

17 So the Muskegon County Waste Water Management System was
18 developed.

19 I happen to be, I guess, the fellow who put the team
20 of scientists together and acted as the lead but I think
21 our waste systems are becoming very complex and there is no
22 such thing as a single disciplinethat is going to handle all
23 the issues. So I don't want to pretend I am the all purpose
24 scientist. There are some things I played a role in, there
25 are others I just more or less coordinated.

1 But the system developed, in essence, brought all the
2 waste with the collecting intercepting system and pumped them
3 inland, the raw waste. This has a relevance. Because
4 these seven treatment plants were occupying some of the best
5 land in that urban area. A nice waterfront site is an extremely
6 valuable piece of land and from a treatment standpoint is not
7 where you should put a sewage treatment plant. So all of these
8 sites now become available for urban redevelopment, for housing,
9 industrial development, parks, whatever the land use plan
10 calls for.

11 The wastes are piped away from the water body, law. In other
12 words, they are being pumped untreated.

13 Senator Boggs. Right now?

14 Mr. Sheaffer. This is under construction, so I can talk
15 with confidence on the price.

16 Out here we built the equivalent of a secondary sewage
17 treatment plant. A secondary sewage treatment plant really
18 returns sludge and it pumps a lot of air into it. But we did
19 it a little differently because we wanted to provide time.
20 Because some of our difficult wastes decompose or biodegrade
21 with time added to the treatment process.

22 Now, when we are over here the land constraint does not
23 permit us to do that. But we are away from the urban area
24 and from about this point out here it is 11 miles. That is
25 all the further we had to go in Muskegon but you can go a

1 hundred miles based on our work. So we come out here and
2 we treat the waste. We reduce the BOD so it is now an odor-
3 less substance. In fact, this is what most urban areas
4 now just discharge into the streams, in other words, after
5 the treatment step you would just discharge it. But if you
6 look at the waste in a comprehensive way you find the danger
7 of talking about BOD and suspended solids because you have over
8 12,000 toxic substances that have been identified in waste and
9 you have 500 new ones made every year.

10 So I don't think you can ever set standards to cover all
11 the toxic substances.

12 After the initial treatment we want to provide tertiary
13 treatment. In other words, this is secondary treatment here,
14 we want to provide tertiary. What we did in Muskegon is
15 we said there are two routes you can take on tertiary treatment.
16 One is you can attempt to do it artificially and the other one
17 is you can attempt to do it naturally.

18 What we looked at is here is a large land resource.
19 The nitrates, phosphates and potassium which were causing
20 prolific algae bloom in these bodies of water, adding to
21 the eutrophication of Lake Michigan, if these are on the land
22 they are called fertilizer; in other words, one inch of sewage
23 effluent on an acre is the equivalent of 25 pounds of 10-10-12
24 commercial fertilizer. So it is a very valuable thing, the
25 effluent.

1 The sludge is not quite as good. So the Muskegon
2 system is designed to use the land to provide tertiary treat-
3 ment.

4 Now, there are a number of things that take place in the
5 land. One is the nitrates, phosphates and potassium fertilize
6 the plants. Another thing is the waste water moving through
7 the soil or the aerobic soil zone, the living filter, remove
8 or have all the BOD residual, the biochemical oxygen demand
9 is removed by these soil bacteria. In other words, they eat
10 it.

11 A soil scientist friend of mine says in every acre
12 there is the equivalent of 20,000 pounds hogs in terms of
13 soil bacteria that eat these organics. The residual suspended
14 solids are removed by the natural filter of the earth. In
15 fact, Dr. Willard at the Thorn Ecological Center in Colorado,
16 she is the one who says that is how we have survived to date
17 because this is the way nature purifies all the waste from
18 the billions of animals on earth. In other words, there is this
19 natural purifying system.

20 Now, when we get into heavy metal and toxic substances,
21 or viruses, let's deal with the viruses, for example, the
22 viruses which are becoming recognized as a problem in our
23 water are positively charged when the Ph of the waste is between
24 6 and 9, which is the range of sewage effluent. They are
25 removed by the negatively charged earth particles. So there is

1 quite a few pieces of research that show once a waste is
2 applied on the land and moves through a soil zone you pick
3 it up, it is virus-free, no one has picked up any viruses.

4 Heavy metals are removed in a number of ways. They are
5 removed by humus in the soil. They are removed by the clay
6 particles, they are taken up as trace elements in two plants.
7 In other words, the idea is to develop a total system. But
8 there are obviously problems with it, as you can see right
9 away.

10 Number One is you are not going to irrigate on a land
11 where there isn't a crop growing. So that raises a question.
12 So, Number Two, if you have a very wet week you don't want
13 to be irrigating when it is raining. So what we did in
14 the Muskegon system is develop some storage basins so that
15 the waste flows in, it is treated and then it goes into
16 storage.

17 Now, these storage basins in Muskegon each are 850
18 acres in surface area. Now, that is for a waste flow of
19 about 44 million gallons a day. So this is a big system. There
20 are not too many systems in the United States bigger than this.
21 We are not talking about a little toy that we think we can
22 scale up.

23 Now, in these storage basins we have the waste and they are
24 applied to the land using rotating irrigation rigs; in other
25 words, it is all automated and evenly distributed. These are

1 these large sprinkler irrigating systems. Then this whole field
2 is underdrained, with pipes so that we pick up the treated
3 waste water. In other words, we give it secondary treatment,
4 we give it tertiary treatment with the soil, and then we
5 collect the waste water that has now been reclaimed and we can
6 do whatever we want to with it here.

7 In other words, we can put it back into a water supply
8 system because this meets public health service draining water
9 standards.

10 If it doesn't, let's say this is a malfunctioning, this is
11 all monitored so it comes right back into the system. You have
12 maximum flexibility.

13 Senator Eagleton. Could you stop there?

14 You have the stuff into those 850 acre lagoons and
15 when it gets in there it is treated secondarily. I am not quite
16 sure what happens in those circles, and everything after
17 that.

18 Mr. Sheaffer. It is pumped out and it is spray irrigated
19 onto the land; in other words, the spray irrigation systems
20 we are talking about are a 1500 foot long pipe that rotates
21 on a center pivot and it has a number of jets along it.
22 Actually in Muskegon they are on the bottom so there is no
23 question of aerosol effects, and then it evenly distributes
24 the waste water on the land. The maximum we put on the land are
25 three inches per acre per week during the growing season. It
goes down to zero in the non-growing season.

1 Senator Eagleton. And that is farm land, there is somebody
2 out there farming that?

3 Mr. Sheaffer. That is right.

4 Senator Boggs. How many acres are involved in that?

5 Mr. Sheaffer. In Muskegon, the total area is 10,000 acres.

6 Mr. Billings. What do you do with it in the non-growing
7 season?

8 Mr. Sheaffer. It is just like any other farm, the land is
9 idle and the water is stored in these holding basins.

10 Mr. Billings. You can hold for six months?

11 Mr. Sheaffer. In Muskegon County under the worse climate
12 conditions, it would have to be 151 days and that is the
13 storage capacity. In other words, for 151 days the waste can
14 flow into this complex and nothing go out.

15 Mr. Billings. Is that including storm water?

16 Mr. Sheaffer. It includes up to a peak of 88 million
17 gallons a day which takes a lot of storm water.

18 Incidentally, storm water runoff from an urban area is
19 a much lower volume than the sewage, it is just that it occurs
20 in maybe 10 or 15 days a year, but if you can store it and
21 spread it out you can treat it with the 15 percent increase
22 in capacity for storm water. But the problem is storing it.
23 Now, with this kind of a system, it tends to be conducive
24 to storage.

25 Now, there are a number of benefits to this system that came

1 in after the system was designed. By using a sprinkler
2 irrigation system, we found that we were developing pieces
3 of land in here in the center that were not being irrigated.
4 They are about 20 acres in size. So we had an unusual situation.
5 We have the groundwater totally controlled and monitored
6 with the drainage pipes under the site and so the point was
7 made that here is where we ought to put our garbage and solid
8 wastes from the city, bring it out here and develop sanitary
9 landfills after we have reclaimed what we can reclaim and we have
10 a good situation where we have the groundwater controlled so
11 if there is leaking from the landfill it is taken back and
12 treated so we protect the groundwater.

13 Incidentally, in this site in Muskegon the 10,000 acres
14 will take care of all the garbage and municipal solid waste if
15 we assumed each person produced 10 pounds a day for the whole
16 country for 150 years. So the solid waste problem is kind of
17 incidentally solved in these spots here.

18 Now, another point which has been brought up which is
19 being worked on very rapidly right now is these two storage
20 basins have a combined surface area of 1700 acres. This is
21 the surface area of the large cooling lakes that are being
22 designed for the Dresden Nuclear Power Plant in Illinois,
23 1700 acres of lake.

24 So the point that is being explored right now is why
25 don't we locate the nuclear power plants which are being

1 controverted over here on Lake Michigan on these types of
2 sites and just modify this storage basin so that we have
3 actually right now there is over 5 trillion gallons in it
4 when it is filled, but design it so that it is a cooling lake
5 and we heat the effluent, we heat the waste water before we
6 apply it to the land and thereby stimulate plant growth; in
7 other words, we use the heat productively.

8 So, in essence, what we are really saying in Muskegon
9 County is on this one site we take all the industrial and
10 municipal waste, we take it, we treat it, we apply the effluent
11 as a fertilizer to give it tertiary treatment, the solids from
12 the treatment process that are removed we apply them to the land
13 through the same irrigation system as the soil conditioner
14 and fertilizer, we provide the space to solve the garbage and
15 solid waste problem, and we solve the problem of locating
16 nuclear power plants and make beneficial use of the heat.

17 In fact, I am a strong advocate that until every urban
18 area has this kind of a waste management area, I don't think
19 we are going to adequately solve our waste problem. We are
20 talking about what was being talked about in Muskegon, that
21 maybe the problem won't get worse. But I think we should have
22 a little higher site than that.

23 Now, this is the way the Muskegon system was designed
24 and there were two immediate responses from the professional and
25 engineering society.

1 The first response was there is nobody that can argue
2 with that conceptually but it really isn't practical, you
3 can't really make it work and get the whole thing designed.
4 There was quite a bit of controversy there and quite a bit
5 of research done in a number of areas, not only at Penn State
6 but out in Arizona, at Phoenix there was work done, at
7 the University of Idaho, in fact there are over a thousand
8 examples where waste is applied on land in some way or other.
9 So that after all this material was assembled, then the point
10 was made, well, of course, you know you can make it work but
11 nobody will ever be able to afford this; in other words, you
12 are talking 10,000 acres of land, you are talking of piping
13 the waste inland, a lot of pumping stations, and then you have the
14 whole system underdrained, the costs are just going to be
15 out of the question.

16 Now, one nice thing about a question of cost is you can
17 readily resolve it by designing your system and putting
18 it out for bid. That was what was done in Muskegon County,
19 and I think it is extremely important to keep this in mind
20 because the cost question is no longer an issue.

21 Now, we had an advantage in Muskegon because they had
22 developed a plan to upgrade these treatment plants.

23 Senator Boggs. Why isn't the cost question no longer
24 in issue?

25 Mr. Sheaffer. I am going to tell you the answer. We had

1 the cost of the alternative system, about \$35,400,000--some.
2 We want to get total costs, we had all the engineering, the
3 administration, the land, we want the cost to be complete. So
4 then it was a matter of costing out this whole system.

5 Incidentally, including the cost of interest during
6 construction, all of these costs were put in. This system
7 came out at about \$35,500,000, including \$3,200,000 for
8 land, an average of \$320 an acre for this land which was
9 very, very marginal, it should not be more than a hundred
10 dollars, probably, but that is not the way it comes out when
11 you start buying large tracts of land. So Muskegon County
12 developed alternative costs.

13 I could leave a write-up of that with you which shows
14 that by going to the land disposal alternative they would save
15 on an average annual cost, in other words, this is debt
16 retirement and operation and maintenance, \$1,150,000 a year.
17 This would be their saving. And this is assuming that they
18 would not get anything from the land in terms of crops.

19 Now, when they presented this in a court case some
20 officials from EPA, who are also called to testify in the
21 court case, and they quarreled a bit with the figures that
22 Muskegon County had because they said their estimates of the
23 conventional treatment were grossly understated and the saving
24 is probably closer to \$2 million a year. So that I think puts
25 the cost question to bed.

1 If you design these kinds of systems based on the only
2 places where there have been detailed studies, and there are
3 three that I know of, the total system, land disposal approach,
4 costs less. I think that is a good indication that there is
5 something worthy of pursuing here.

6 Mr. Jorling. There is no value in there for the increased
7 quality of the receiving waters?

8 Mr. Sheaffer. No, this is strictly what it costs you to
9 get the system in and operate.

10 Mr. Guard. And you have no discharge?

11 Mr. Sheaffer. Right.

12 Mr. Meyer. What happens to the seven plants?

13 Mr. Sheaffer. These are all going to be eliminated.
14 Incidentally, the cost in the land disposal alternative included
15 \$300,000 to purchase the existing plants and eliminate them.

16 Mr. Tozzi. You might explain why the economics of moving
17 those plants were cheaper, in other words, it was an
18 economic comparison that it is a lot cheaper to scrap those
19 than it was to continue their operation. It may not be the
20 case in every urban area but it would be the case in that area.

21 Mr. Sheaffer. The cost of treating a million gallons
22 in an existing plant versus the cost of treating it here one
23 can make a very quick economic analysis to determine whether
24 it is desirable at this point in time to eliminate them. You
25 may phase them in, that is a point I would like to mention later.

1 But if I may continue here, I think there is some
2 interesting things that happened in Muskegon. Some people have
3 said, well, that sewage effluent isn't really going to be of
4 any value. The private market won't recognize it. Now, in
5 Muskegon County the State required the county to buy the land.
6 Now, I would like to see areas where you would buy it and then
7 sell it right back to the private owner and have an irrigation
8 easement in the deed, but that wasn't the choice here. It had
9 to be bought. So that the county owns the land.

10 Now, it is going to be applying irrigation water and you
11 might say what is the agricultural community going to say that
12 is worth?

13 Muskegon County just signed a contract with Continental
14 Teledyne, a big conglomerate, to operate this farm and
15 this system as a sharecropper and the contract says the first
16 \$150,000 worth of crops from this land go totally to the county.
17 This is the incentive to make the farmer produce more than
18 that. The next dollars are split 66 cents to the county
19 40 cents to the Continental Teledyne until they get up, until
20 the county gets another \$214,000 which is the total cost of
21 operating the system. Then, after that each dollar is split
22 equally 50-50.

23 Now, there are some projections which show that because
24 the county took this kind of a sewage treatment system they
25 will get a cash payment of about \$614,000 a year. In other words,

1 sewage treatment makes money. It may not totally eliminate
2 the cost but it is a system which produces revenue because
3 you are growing crops on thousands of acres of land. You are
4 putting fertilizer and water on it and you have it underdrained
5 so that it can't become waterlogged and get those adverse
6 effects.

7 Senator Boggs. What kind of crops would that grow?

8 Mr. Sheaffer. A favorite crop of mine would be corn
9 and soybeans are another possibility. If you want to go to
10 marginal things, you would go like to reed canary grass,
11 which a lot of people have talked about. Incidentally, it
12 could be a forest land. I am explaining row crops. Where
13 topography became uneven you may fertilize forests.

14 Senator Boggs. May I ask just one other question?

15 Is that flat country?

16 Mr. Sheaffer. Fairly flat, yet.

17 The attitude of the industries in the county, I think,
18 is worthy of note, because this is a highly industrialized
19 community. Scott Paper Company has a large paper mill there.
20 Ott Chemical Division of Corn Products has a large facility
21 there. Hooker Chemical, duPont Chemical are there, Lakeway
22 Chemical. You have Continental Taledyne which is a heavy
23 metals operation, Sealed Power and the piston rings, you have
24 a good mix of industries.

25 The important thing is that the industries when they were
presented with this system became the strongest advocates of

1 it and in fact I think were very instrumental in seeing that
2 the system got to the point where it is now being constructed.
3 I have concluded that industries are not trying to shun
4 their responsibilities because these industries are paying
5 more than half the cost of the system. In fact, the paper mill
6 in the first year is going to be paying 55 percent of the
7 total cost.

8 So it isn't getting a free ride, it all but it was a strong
9 advocate and their attitude was if we design these kinds of
10 systems we know what it is going to cost, we know the
11 question of add-ons and changes and so forth that in each three
12 or four years is gone forever.

13 Senator Boggs. The paper mill is strictly industrial waste
14 with a lot of pulp and chemicals in it.

15 Mr. Shaeffer. Right, a lot of clay, too. Most paper mills
16 have a problem of color removal. You put on the land here
17 and you totally remove the color and the problem with heat
18 is taken care of. This paper mill, incidentally, doesn't even
19 have to pretreat. All the fiber and sludge go in because this
20 system can readily accommodate fiber and sludge.

21 Mr. Jordan. Could you explain in some detail how it is
22 being financed through private and public administration?

23 Mr. Sheaffer. The system, the financing of a regional
24 system is kind of an interesting thing. What we did in Muskegon
25 County was this. We developed what we called a service area;

1 in other words, everything that one would suggest was going
2 to be urbanized by 1990. The service area, then, was treated
3 as if every acre was equal, in other words, any acre had an
4 equal ability to attract a motel or an industry, whatever
5 it was. So that there was an annual land charge or we call
6 it an access fee of each acre, whether it is developed or un-
7 developed. Now, in the process of hearings, if I have a farm
8 here I had the choice to say I don't want to be in your
9 service district and if I so chose the county backed up
10 its service district with a very rigid septic tank ordinance.
11 So that they were assured that somebody was not going to be out
12 here with 500 foot lots with septic tanks, in other words they
13 were going to require more than an acre lot for a septic tank.
14 So that the service area did a number of things, it provided
15 a base for the financing of the capital but it also gave
16 a control to urban sprawl.

17 Incidentally, this large land irrigation area cut off
18 the route of urban sprawl, 80 percent of the route, which
19 I think is an extremely important planning tool. But the
20 service phase are used to finance a part of the capital costs
21 and then the user fees, in other words, people who discharge
22 into the system, all pay proportionately on a gallon basis.
23 In fact, if you discharge 2 million and I discharge 10,000,
24 we are all paying the same rate.

25 Senator Boggs. All paying the same rate but for the volume

1 you pay more?

2 Mr. Sheaffer. That is right. So that the fee for the
3 user fee is used both for operation and maintenance and sinking
4 funds plus it pays a part of the capital cost.

5 Now, this is a very acceptable system and since it was
6 developed here the county used it on two other occasions in
7 a water supply extension.

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1 Mr. Jordan. You said that Scott would pay 55 percent of
2 the capital costs, is that over a period of time?

3 Mr. Sheaffer. I said in the first year. You see what is
4 happening here, and I think it is ideal, when you start the
5 system industries are using this much and municipalities are
6 using this much and there is more industrial flow than municipal
7 flow. But as we project to 1990, like for example the paper com-
8 pany is planning to reduce its water use from 16 million gallons
9 a day down to 3 million, and the municipal use as sewer lines
10 are extended, because about 40 percent of the people are not
11 served by sewers, this is going to go up.

12 So that we have an ideal system. We have very little unused
13 capacity at the very beginning, which I think is an advantage
14 of a regional system. If you get the industry and municipal
15 units in a single system, most projections of industrial water
16 use show them going down and they go into more water conserva-
17 tion measures, and as the population goes up. In other words,
18 we have a very narrow belt of unused capacity at any point in
19 time.

20 Now with this kind of a system, incidentally, I guess
21 that one reason why Mr. Beall and Mr. Jordan -- first, Mr.
22 Jordan asked me to come to the Corps of Engineers or the Secre-
23 tary of Army's office and act as their science adviser. The
24 idea is how could we develop regional waste water systems that
25 are different from the traditional approach so that we have

1 some choices to make. Not that we would always do this, but
2 that at least we knew what choices we had.

3 Now this was a problem to me because I am not a career
4 man in the Army or the Corps. In fact, some people in the Corps
5 would probably say I am one of their worst enemies when I am at
6 the University of Chicago.

7 The thing that influenced my own personal decision was as
8 I looked at the water quality efforts in the United States, I
9 felt we only had half a program. I think you can summarize the
10 national program as saying that we assist in the setting of
11 standards, we make construction grants, and we monitor water
12 quality.

13 We have a little research effort that kind of feeds into
14 all of them and once in a while a few dollars are made available
15 for planning under the Section 3(c). Now if we look at that, we
16 can see that there are a lot of areas that are missed and the
17 most crucial one is planning. We could ask ourselves the ques-
18 tion under existing situations would this kind of system ever
19 be planned?

20 I have concluded that it never would. Now I would also have
21 to admit that it is theoretically possible, but I would just
22 not see this kind of system being developed. The reason I don't
23 see it being developed is this kind of a system requires a whole
24 new range of expertise than what is generally addressing the
25 water quality problem. That is why I decided to come with the
Army.

1 When you are talking about this system, you are talking
2 about soil experts, people who are expert in foundations, drill-
3 ing, just like if you are building a land or a levee, you drill
4 out the soil, you determine the geology. It involves a lot of
5 earth-moving because these are above-ground reservoirs. This is
6 just a long levee joined together at one end. So earth-moving
7 experience is very important, large pumping stations, underground
8 drainage, the real estate people who can assemble large tracts
9 of land.

10 Incidentally, in an unnamed river basin where there were a
11 number of reservoirs proposed to improve water quality, those
12 reservoirs would inundate more land than would be required to
13 put all the waste on the land.

14 I have worked that out in a number of cases, because we
15 have these kinds of choices. Whether you assemble a large amount
16 of land at a reservoir site or at a waste treatment site, this
17 same process is involved.

18 When I looked at the Federal Government all these talents
19 and disciplines are right in the hand of the Corps.

20 Senator Doggs. How long can the land absorb this before it
21 is saturated?

22 Mr. Sheaffer. This is, I think, -- you can build a good
23 case to say that this is a permanent system. Now the first
24 problem in my opinion would be the heavy metals, because you
25 are using the earth as a sink for the heavy metals, you are just

1 building them up. The management technique is to spread them
2 over enough area that they will never accumulate to a concen-
3 tration during your operational period where they will be either
4 toxic to the soil or the plants.

5 Now we sent a man over to Berlin and Paris where they have
6 had a lot of experience with sludge farming and this man went
7 over, his assignment was to determine how many heavy metals
8 were being applied to an acre because the literature showed
9 that after 70 years there was a problem. In other words, the
10 land production dropped off very quickly and then they would move
11 to another site.

12 So I don't think 70 years is a suitable planning time. In
13 order to be ultrasafe we spread the waste over 25 times more
14 land than they were being spread in Berlin and Paris, and some
15 people have said that means you have 1,750 years.

16 Now I think that is kind of ridiculous, but the point is
17 I think you have a system good for a couple of hundred years
18 without any question. In fact, here the first thing you would
19 run out of would be space for the garbage because that would
20 be after about 150 years. But I think the system is a permanent
21 one and I think based on the experience here in Muskegon and
22 the costs and the bidding that we ought to expand a range of
23 choice that is available to local units of government, particu-
24 larly the states.

25 Now I view, I think that we could move very quickly on this

1 kind of a system if we initially used the abilities in the
2 Department of the Army to prepare these alternatives, just to
3 show the range of choice that is available in each locality.
4 The choice and the implementation, I think, the states have to
5 play the lead. In other words, I don't want to see an all-
6 Federal program, but I do feel when we are talking about these
7 systems, particularly if this is 100 miles instead of 11 miles,
8 particularly if there is a stateline in between, because many
9 of our urban regions involved more than one state.

10 Senator Boggs. There is no state or Federal financing in
11 your project?

12 Mr. Sheaffer. In the planning, the planners in Muskegon
13 County had money from 701. They had some R&D money, but it was
14 primarily done as a research project at the University of
15 Chicago, which I used my people on and so it was kind of a gift
16 to them because they did not have enough money to develop this
17 kind of a system right.

18 Senator Boggs. But after this initial planning has been
19 accomplished and you go in and you let the contract and you con-
20 struct and you go operational, the financing of it and the caring
21 of it is local?

22 Mr. Sheaffer. No. In other words, they are using the
23 construction grants just like any other system right now and
24 they also have state matching money in Michigan. The local bond
25 issue was \$16 million, which they sold on the 15th, incidentally,

1 at 5.73 interest, which was a half percent below the market
2 New York sold them the day before at 7.5 percent. So it shows tha
3 the financial community analyzed this system and there were four
4 bids, and they all come within .1 of one another, so they were
5 all trying to get it.

6 Senator Boggs. What does the Corps of Engineers do? What
7 is their planning?

8 Mr. Sheaffer. In our waste water management program what
9 we are doing in six major areas -- and the areas are the
10 Boston-Harrimack River Basin, Cleveland-Akron urban complex, the
11 entire Detroit metropolitan area, Chicago-Northwest Indiana, and
12 San Francisco-Sacramento, the whole Bay Delta area, plus the
13 Susquehanna River Basin.

14 Incidentally, that is 15 percent of the population in the
15 country and about 25 percent of the population at sewers, so
16 we are taking a big chunk in the pilot program. What we are
17 doing is laying out on a survey scope all alternative waste
18 water management systems.

19 Now we are laying out advanced waste treatment and we are
20 laying out land disposal, we call it water disposal and land
21 disposal alternatives for these six areas. And I think the
22 timing is important because this is being done in a year and a
23 half. I think the timing is important in Muskegon County because
24 some people have argued with me. They said if you try a new
25 approach, all you are going to do is delay the program five years.

1 Muskegon County on February 26, 1969, decided to prepare
2 a plan and we have them in July of 1971 constructing a plan
3 that had tremendous difficulties, because you had to get 13
4 municipalities to join in a single system.

5 You had to get major industries to join in a single system,
6 you know corporate decisions being made in New York and Phila-
7 delphia and Detroit. So in a little over two years and four
8 months we go from the idea of preparing a plan to construction
9 and, incidentally, the system is going to be operation in part in
10 July of 1972 and totally operational in the early part of '73.

11 So we are talking about less than four years, the system
12 going from nothing to a total system.

13 Mr. Jordan. I think during the last six years we have made
14 a tremendous investment in new municipal waste treatment facili-
15 ties on bodies of water. If we were to operate for the inland
16 treatment process is there anyway, we can use these new capital
17 investments in the treatment?

18 Mr. Sheaffer. Yes. This is a good point and it is some-
19 what complex. In other words, the point was raised in Muskegon
20 could we just pick up all the effluent from these plants,
21 transport the effluent out and irrigate and get the benefits of
22 the nutrients and provide tertiary treatment on the land and
23 then bring it under drainage back?

24 In an ideal situation that is a real possibility. It would
25 have to be worked out in each system. The real difficulty with

1 that approach is the unreliability of the system we have
2 invested a large sum of money in. In other words, a secondary
3 treatment plant isn't a very reliable system. It looks good only
4 when you talk of averages.

5 I have worked with a number of secondary treatment plants
6 that were well operated and if you get a change in pH or you
7 get a toxic spill, the bacteria are all killed and so there is
8 no secondary treatment until you get a new colony of bacteria
9 established.

10 The systems I have worked out this with occurred on the
11 average six times a year and it took from six to ten days to
12 get the colony reestablished, so you are talking about 36 to
13 60 days a year you have no secondary treatment. That means
14 then you have to provide some backup treatment or make this a
15 more reliable system.

16 Now I think this can be weighed in any situation and you
17 can make an economic determination as to whether or not you should
18 scrap what is there or whether you should use it and then pro-
19 vide some backup system and then go to the land. I think they
20 can be fed in in a very what we might say systematic and very
21 cost effective way.

22 Senator Tunney. Is there the technical expertise available
23 to be able to make this type of systems analysis in more than just
24 a handful of communities? At the present time I would imagine
25 that there is a real shortage of qualified experts to be able

1 to make this type of analysis.

2 Mr. Sheaffer. I think we have a fairly good reservoir of
3 talent in these areas. In the couple of years that I have been
4 work with it, I have seen just kind of a momentum going and it
5 draws in different disciplines. In other words, this kind of
6 a system does not depend on a traditional sanitary engineer. In
7 fact, he could not design this kind of a system. It requires
8 a team so you are bringing in geologists, and hydraulogists and
9 hydraulics men and different medical people have been involved
10 in this system, you bring in soil scientists, sothat you are
11 kind of broadening the type of people that get involved.

12 I think, if anybody is interested in my opinion, that in a
13 five-year crash program we can develop these kinds of alterna-
14 tives for the entire country. They are implementing, the choices
15 that are made, that I think is a local prerogative or a state
16 prerogative. But I think based on what we now know, everybody
17 should have an opportunity to make these kinds of choices and
18 get a total management system.

19 Mr. Meyer. In terms of payoff has there been any estimate
20 of what happens to the quality of the water in those two lakes
21 that feed into Lake Michigan when you do that?

22 Mr. Sheaffer. Oh, yes. In fact, EPA has even said this,
23 these are going to be dramatically changed in a very short
24 period of time because we are going to instantly cut off all of
25 the point and some of the area discharges, particularly the

1 urban runoff, from these lakes and all and these lakes have
2 rivers flowing in them, so they are going to rejuvenate them-
3 selves very quickly.

4 Mr. Meyer. Going back to the pamphlet you put in here in
5 following up on that question, in the Muskegon County area you
6 also have five or six very large communities within a relatively
7 short distance. What happens in this area if they don't follow
8 up with a comparable kind of approach to the quality of water in
9 the area? What about the upstream communities?

10 Mr. Sheaffer. In Muskegon River Basin the communities are
11 all pretty small upstream and they are quite a few miles upstream.
12 The county has already initiated discussions legally to force
13 them to a no-discharge system also. In other words, it is
14 really becoming local initiative saying, "Look, we are going to
15 get rid of all the wastes in our area now. Anybody upstream, we
16 want you to follow suit."

17 Senator Boggs. This is other counties?

18 Mr. Sheaffer. Yes.

19 Senator Boggs. But all of the small villages and everything
20 in this Muskegon County are hooked in?

21 Mr. Sheaffer. Everything is in a single system.

22 Mr. Meyer. Using this map on page 1, you are working in
23 Detroit on one of the pilot studies?

24 Mr. Sheaffer. Yes.

25 Mr. Meyer. Now back from Detroit you have Flint and

1 Lansing. Do they feed into the same water systems?

2 Mr. Sheaffer. No, you have Lansing and Kalamazoo and
3 Grand Rapids, that is all in the Grand River Basin, that is all
4 in the Grand River Basin.

5 Mr. Meyer. So they are not in that pilot study?

6 Mr. Sheaffer. If you take Michigan, most of it drains to
7 the west and our pilot study we have all the drainage that comes
8 to the east and into Lake Sinclair, Detroit River and Lake Erie.
9 Incidentally, I think Lake Erie could rejuvenate itself just
10 like Muskegon Lake and Mona Lake, because it is just a wide river.

11 Senator Boggs. I think your presentation is terrific, but
12 I would think in my own area, I am from Delaware, we just don't
13 have the acreage to do it.

14 Mr. Sheaffer. Oh, sure you do. Let me give you an idea
15 of how much land you need. In the irrigation area you are
16 using 143 acres for every million gallons of waste. Now let's
17 say the State of Delaware, which I think has tremendous resources
18 and could get all the waste on its land, that happens to be an
19 area I have been looking at just out of my own interest ---

20 Senator Boggs. We tried to push one project for the City
21 of Harrington along the Penn State line, I remember, but we
22 didn't get anywhere with it.

23 Mr. Sheaffer. Generally because the systems are not
24 properly designed and presented. If we took the country as a
25 whole, it would take less than 2 percent of the land area we

1 harvested for crops in 1963 to get all the waste on the land.
2 We are not even changing the land use, we are simply changing
3 the method of irrigation and fertilization.

4 Senator Boggs. Here you have a chemical industry up there,
5 its wastes include a lot of acids, I suppose, doesn't it?

6 Mr. Sheaffer. Yes, some acids.

7 Senator Boggs. How do you handle the acid? Do you have to
8 make a special arrangement?

9 Mr. Sheaffer. WE had to take all the wastes together and
10 mix them up and we did a six-month sampling period to know whether
11 the system would work. In other words, you don't want your
12 waste to come onto the land in an acid form because it is very
13 important that its pH is between 7.2 and up to make certain
14 that the phosphates are precipitated out.

15 Now if the waste water came to the land, and this is where
16 a lot of people get confused, if the waste water came to the
17 land in an acid form, the phosphates would not precipitate out
18 and it would go through the soil. But when it comes at a pH above
19 7.2, then the phosphates are precipitated out either by the iron
20 and aluminum in the soil or if you are out in a desert area,
21 by the calcium in the soil.

22 So if you had an acid waste, you may have to neutralize it
23 before you go on to the land. But that is a very minimal task
24 to do that. In other words, you would have some kind of lime
25 application along the system. But this would have to be worked

1 out in every area.

2 Senator Boggs. This is probably inconceivable, but can
3 you visualize the day when private industry is going to see a
4 profit in doing this and will come to the county and say, "Let
5 us bid on this project and take the thing over and we will give
6 you an annual service charge"?

7 Mr. Sheaffer. I certainly do see that day. I think in
8 particular maybe not for the very largest of systems, but after
9 you got through the first 20 large urban areas, 25 large urban
10 areas, I think there is no question about that is going to come
11 about.

12 Incidentally, the operation of the Muskegon system was
13 really a controversy because Dow Chemical was bidding against
14 Continental Telephone and Inland Steel wanted to get into the
15 act. In other words, there were three major corporations ---

16 Senator Boggs. To do the farming?

17 Mr. Sheaffer. To operate the system and the farm and, in
18 fact, both Dow Chemical and Continental Telephone gave competing
19 proposals to the county.

20 Senator Boggs. So to operate the whole system Continental
21 Telephone got it?

22 Mr. Sheaffer. Everything, they operate the pumping stations,
23 the treatment, the lands, they grow the crops, and Continental
24 Telephone formed a separate division and they feel it is going
25 to do exactly what you have suggested; in other words, that they

are going to go to local units of government and say, "Look, let's develop the whole package of solid wastes, the effluents, the sludge," and you know, you sign a term contract.

Mr. Jorling. In the operation and maintenance cost savings you projected into this it must have included power requirements. This system will have considerable power demands, I imagine. Can you use nonpeaking power?

Mr. Sheaffer. You can to a degree, but they did not get that good a price. But the point is the power requirements are more in this land disposal system than in the water disposal, but not quite as much more as you think because if you go through a sewage treatment plant, it is really a system of pumps, it pumps it from this well and drops it down here and so there is a lot of pumping in the system.

Mr. Billings. Have you done a calculation between the trade-offs between the costs to utilities and building the closed cycle cooling system as opposed to providing free electric service?

Mr. Sheaffer. No. But one thing I like about the nuclear power plants here are not only do you have their own cooling system and you make it take advantage of the heat, but you have it surrounded with a large agricultural buffer which addresses a lot of questions people say about failure and radiation hazards and so forth.

Mr. Jorling. You said if you developed a proper five-year

1 crash program, you could visualize the time when each of the
2 major communities could develop a system like this. I know some
3 of the costs are unidentifiable, but how much did the plan cost
4 for Muskegon County? In other words, if you were going to
5 take the metropolitan communities above 300,000 in the country
6 and estimate the costs to develop these kinds of plants, how
7 much would this cost?

8 Mr. Sheaffer. All of the planning design and administra-
9 tion in Muskegon Country came in at about \$3 million. Now if
10 you talk about the actual plan, you are talking somewhere around
11 around \$350,000.

12 Mr. Jorling. Which is the cost it is lacking now, for
13 instance, if you went into a Section 209 question like you have
14 seen in the draft and then for those who were designated ini-
15 tially in the first round, at least \$350,000 would have to be
16 there?

17 Mr. Sheaffer. If you take 200 urban areas, they are not
18 going to average over a million dollars each for planning costs.

19 Mr. Billings. You have examined obviously the trace metals
20 questions to some degree. If you are growing crops which may be
21 used for animal feed, is there any possibility of concentrating
22 up the food chain in dairy products and so on?

23 Mr. Sheaffer. I would assume we would grow all of these
24 crops for animal feed or for processing and you are out of my
25 field, but this has been talked about quite a bit and discussed

1 and I have always been told like, for example, the nickel-cadmium
2 ratio would change a bit in corn, but be well below what was
3 the safe limits even for human beings to eat.

4 Now most of the experience has shown that like, for example,
5 lead, you can get into some of the root zones, but the people
6 who maintained this system thought that it would never come up
7 into the stalks. So they ruled out growing plants where the
8 animals would eat the roots, just where you harvest the stalks.

9 Mr. Billings. The system would be safer if there were some
10 kind of pretreatment of the toxics?

11 Mr. Sheaffer. I think in every system you have to go into
12 the industry and you do them a service when you work toward the
13 recovery of metals which they may be losing, nickel or chrome.
14 In other words, I would never say that you develop a system
15 and say anything that anybody feels like dumping in, they put
16 in.

17 You see, Muskegon County developed an industrial waste
18 ordinance, and I mean they worked with the industries and they
19 have limits on what you can put in the system. There is the
20 idea there to have the system serve the area to the maximum degree
21 practical, but don't present it as if anything you feel like
22 discharging you can discharge.

23 Senator Eagleton. You have said you are examining five
24 other areas, or six, and they included some very big ones like
25 Boston, Chicago, San Francisco, Detroit, what are the pitfalls

1 of the problems that you encounter as you try to take this basic
2 concept and apply it to any of those systems that you have looked
3 at? Does it all blend in very smoothly or are there some road-
4 blocks that appear because of topography, concentration of popu-
5 lation, et cetera?

6 Mr. Sheaffer. In terms of practical or technical feasi-
7 bility, you don't run into problems. The Boston-Merrimack River
8 Basin area is probably the most difficult in which you could find
9 sufficient land to implement this kind of a system. I worked
10 with the team up there, though, and we have identified more
11 than sufficient land to deal with the flows up to 2020, which
12 is pretty considerably bigger, more than double what they have
13 today.

14 With respect to topography I think we have always been
15 able to find the land, and I feel that it is an open alternative,
16 even to a place like New York City. It creates institutional
17 questions like crossing state boundaries. There is always going
18 to be the question of the local area, because just like nobody
19 wants to move from an urban renewal area, nobody particularly
20 wants to be moved from a land disposal area.

21 So I think the uniform relocation act mitigates a lot of
22 the problem there, because those people in the land area would
23 get the same treatment as if they lived in an urban area.

24 Mr. Jorling. This land that was used for the disposal
25 site was in Muskegon County, so who condemned the land?

1 Mr. Sheaffer. The county is trying to get it all without
2 condemning it. But I think Michigan doesn't have a quick-take
3 law which is kind of a problem. The quick-take law just only
4 applies to highways in Michigan. So they have to expand it and
5 the Legislature has this under consideration.

6 Mr. Meyer. That problem can be met exactly as the problem
7 was met with highways in '56, and if you want to go that route,
8 you provide Federal backup authority where quick-take doesn't
9 exist at the state level.

10 Senator Tunney. I was interested in your comment that you
11 felt that there was a capacity to achieve this type of system
12 within five years for every community in the country. What
13 would you consider the cost to be? Have you gone into that at
14 all?

15 Mr. Sheaffer. Yes. I did some general calculations. If
16 we took the Muskegon system and took the total costs, this
17 includes all the engineering, the financing charges, the land
18 costs, and divided by the millions of gallons it serves, we are
19 talking about a \$800,000 cost per million-gallon capacity.

20 If we took the 205 million people in the United States and
21 assumed that they are all on systems and they all produce or the
22 waste load is equivalent of 150 gallons per capita per day, we
23 find ourselves with about 30,750 million gallons, and if we take
24 that time the 800,000, we come in at a cost of about \$24.6 billion.
25 In other words, it is about \$25 billion which would be the price

1 tag, and that would include all the planning and the design
2 work.

3 Senator Tunney. Do you see any reason at all why you
4 can't establish a National Water Quality Standard within ten
5 years in this country?

6 Mr. Sheaffer. I think within ten years we should not even
7 talk about a standard, we should be talking about no-discharge.
8 In other words, we should not be using our water to convey
9 wastes. I think within a ten-year period we should have all of
10 this implemented and we could go on to more important jobs and
11 I will be out of a job.

12 But I want to work my way out of a job rather than keep it
13 going to perpetuity.

14 I think Mr. Sawsowicz and his chief engineer, Forest Neal --
15 Sawsowicz has looked at this and he has appeared with your com-
16 mittee and he is strongly advocating that he can buy land for
17 the sludge. I don't think he feels that one could ever pull off
18 this kind of a total system.

19 So he is kind of moving partway. I think he says that
20 the land has to be used for the sludge and, in fact, General
21 Jensen mentioned that to me. He said you get the whole works
22 on the land and he said, "I am having trouble getting sludge
23 on the land."

24 Mr. Guard. Your sludge is spread out with the effluent?

25 Mr. Sheaffer. Not combined. You allow the sludge to

1 accumulate, that is the reason for the two lagoons. You allow
2 it to age in the one and after it has aged for a year and you
3 accumulate enough of it, then you use a suction dredge and you
4 suck it out and apply it on the land.

5 Mr. Guard. It is applied on the land as sludge?

6 Mr. Sheaffer. Yes, as a soil conditioner and fertilizer.

7 Senator Eagleton. Where does Sawsowicz cut off your system?

8 Mr. Sheafffer. Right now he is operating under a private
9 contract. The solids that are removed at a sewage treatment
10 plant, I think we really miss what a sewage treatment plant is.
11 It is just a separating device. So what it has separated out,
12 they don't really know what to do with.

13 Sawsowicz signed a contract with a private corporation,
14 Soil Enrichment Materials Corporation, in Illinois, and they
15 load this sludge into a train, a unit train or 30 cars, two
16 trains, and they haul it 160 miles south and they unload it and
17 spray it on the land as a soil conditioner and fertilizer.

18 Now he wants the act to read so that money is provided to
19 buy land to dispose of the sludge. He has bought a piece of
20 land in Fulton County, Illinois, and he wants to buy more land
21 and he wants to build a pipeline rather than a train and a
22 pipeline is less costly.

23 It is just that you can start up with a train next week.
24 If they built a pipeline, it would be a couple of years until it
25 would be built.

1 Mr. Meyer. How does he provide the storage problem?

2 Mr. Sheaffer. They provide storage down at the crop area,
3 there is a large lagoon developed where the sludge is unloaded.

4 Mr. Meyer. What more do you do than that?

5 Mr. Sheaffer. We take the effluent, too; in other words,
6 everything goes away from the water rather than just the solids
7 that are removed.

8 Mr. Billings. Does Muskegon take its water supply from
9 these rivers, from the lake?

10 Mr. Sheaffer. Muskegon takes its water supply from the
11 lake.

12 Mr. Billings. And under its present program it discharges
13 back into the rivers?

14 Mr. Sheaffer. Yes. Well, it discharges into these lakes
15 which are extensions of Lake Michigan.

16 Mr. Billings. But that is the same water system. Now you
17 are talking about how many million gallons?

18 Mr. Sheaffer. 44.4 million gallons a day.

19 Mr. Billings. You are talking about taking out of the
20 regular water cycle some 44 million gallons a day; if you do this
21 for all the communities around Lake Michigan, for example, the
22 communities that are withdrawing water from the lake and you have
23 no return flow, aren't you going to deplete the water resource?
24 Will it change drastically?

25 Mr. Sheaffer. You have a potential return flow. In other

1 words, the water comes out from the ground water. This would
2 be about 80 percent of what went in. All you could lose, all
3 that you can lose is the difference between potential evapora-
4 tion and actual evaporation.

5 Mr. Tozzi. You are talking about the underdrains that
6 you can control.

7 Mr. Sheaffer. They are talking about what do you lose to
8 the atmosphere?

9 Mr. Billings. I am talking about what you lose to Lake
10 Michigan.

11 Mr. Jorling. You are interpreting this question in terms
12 of how much would be lost from the system, and I think he is
13 concerned about how much you would lost from the cycle at a
14 particular point, like Lake Michigan.

15 Mr. Sheaffer. The flow that comes out here meets draining
16 water quality standards. There are three choices in Muskegon,
17 One is to use it for water supply, but they already have an
18 overdeveloped system over here, so they don't need any more
19 water supply.

20 Another possibility is use it for industrial development,
21 and there are a number of industries which have inquired about
22 it because this is a uniform temperature and it is the sort of
23 water flow that an industry likes. But in the process that is
24 not developed either.

25 So what Muskegon County does with it is they are taking

1 it and putting it in this stream which flows into Mona Lake,
2 because it has no flow in the summer. In other words, they get
3 a recreational and aesthetic benefit from it. So they are getting
4 80 percent of their water back into the system.

5 Mr. Billings. Into Lake Michigan?

6 Mr. Sheaffer. That's right, they have chosen to do that
7 because of their particular set of circumstances.

8 Mr. Billings. Is there cause for concern if the communi-
9 ties on Lake Michigan were to all go to this kind of system and
10 have a 20 percent drydown. I realize the Great Lakes have a
11 drydown problem as it is. Would this be a problem?

12 Mr. Sheaffer. I don't think so, because of something I
13 can't prove, but the point is you are not losing any water and
14 we believe in the hydrologic cycle it is just where the water
15 is and I think that we will get perhaps just a little bit addi-
16 tional rain over in another area that drains into the basin.

17 The point is the water has to be someplace.

18 Mr. Jorling. If this system were put into Chicago and
19 assuming it was in the drainage basin, then you would keep in
20 the Lake Michigan hydrologic cycle water which is now being sent
21 down the Mississippi?

22 Mr. Sheaffer. All of the Chicago wastes go away now, so
23 that is true. It could bring some back.

24 Mr. Tozzi. That relates to a question Senator Eagleton
25 asked as to some of the shortcomings. It gets to be a very

1 debatable issue. You see there are underdrains on that whole
2 system and the question is after you get that reused water, who
3 gets the reused water? In these plans we are developing there
4 is a whole series of alternatives of what you could do with that
5 reused water.

6 There is no obvious solution whether you put it into one
7 area for irrigation and another for M&I water supply. So one
8 of the questions which will come out of the first phase of our
9 studies which will be finished this month is the debate of what
10 you do with that reused water.

11 There is a lot of demands for that reused water.

12 Mr. Jorling. Under this particular system that county
13 holds tightly to that water under Michigan water rights?

14 Mr. Sheaffer. Yes. Incidentally, in our Chicago area we
15 have developed an elaborate redistribution system to bring the
16 water up and place it in a number of streams which have very
17 little flow in the summer, but which have a large recreational
18 potential.

19 Mr. Meyer. On scale how far down can you scale this thing
20 with the present state of the art on community size?

21 Mr. Sheaffer. There is no problem in scaling it up. Some-
22 thing which I did not present to you, which I think in your
23 little pamphlet is shown, if you look on page 2 of the little
24 pamphlet, there is a small system around White Lake to the
25 north. The 43.4 million gallons is really in two systems. There

1 is 42 million gallons a day in one main system, which I used
2 for illustrative purposes, and then up here in the north there
3 is 1.4 million gallons in the White Hall-Montagne area, and
4 that 1.4 was studied not only by the county, but the local com-
5 munities had a consulting firm from Ann Arbor, McNamee, Porter
6 & Sealey, and they studied the two systems and concluded that
7 the land disposal alternative for that small part of the system
8 was the most economical. It is about 9,000 people.

9 Mr. Billings. Would we need a retraining program for
10 obsolete sanitary engineers?

11 Mr. Sheaffer. No, because there are a lot of things that
12 sanitary engineers are involved in.

13 When I was going to get aerators, I didn't think we ought
14 to put a concrete tank with an aerator in the middle because I
15 think that is a very costly way to do it. What we did was made
16 a cell or an earth embankment and put a lot of aerators in it.
17 So that cuts the cost of construction tremendously. Instead of
18 having 12 concrete tanks each with an aerator in it, I have one
19 cell with 12 areas in its.

20 Mr. Meyer. Going back to the question that Tom Jorling
21 asked you about, if you go this route since you are talking
22 about water supply and hydrological cycling and everything else,
23 aren't you really in effect forcing the Corps to re-examine all
24 of its program in terms of alternatives?

25 Mr. Sheaffer. That is what I think is being done, I think

1 that is part of the reason why I came to Washington, because I
2 think we have a big reservoir of talent that could lead the way
3 toward achieving the quality of environment that we want. But
4 I think we ought to use it where we have it instead of talking
5 about reorganizing, because I have watched.

6 With this system I can clean up the water and be providing
7 low flow.

8 Mr. Tozzi. This could really change the size of a lot of
9 reservoirs, because when the Corps goes in and looks at the
10 water quality problems, at least their interpretation of the
11 statutes that allow them to plan, the tool that they have avail-
12 able to them is storage, which means that you dilute the flows.

13 Really what Dr. Sheaffer is saying is should their range
14 of choice be that, you put in these types of alternatives in
15 competition with low flow and you look at both the economics
16 and the costs with separate measures.

17 Mr. Meyer. The same thing is true, I assume, for municipi-
18 pal water supply where you are talking about the storage capacity?

19 Mr. Tozzi. Yes, the reuse of this has big potentials about
20 changing the amount of storage for industrial and municipal
21 use.

22 Mr. Guard. You have 400 authorized and not started yet?

23 Mr. Sheaffer. Just to sketch out something which is of
24 interest to me is New York City in relation to the Delaware
25 River Basin, the transfer of water from the Delaware to New York,

1 the problem of salt water moving up to near the water intakes,
2 the problems of water quality in the Delaware because of reduced
3 flow.

4 There are two places where New York could take its wastes
5 within a hundred miles of the city. One is over here in this
6 whole Pocono Plateau area, another one is up here in the Cats-
7 kill Mountains where you would irrigate forest land, the under-
8 drainage of all the water would come back into the Delaware
9 and we would have a tremendous, I think very dramatic program
10 designed in the Delaware River Basin for water supply, for low
11 flow augmentation, for recreational purposes and also we have
12 taken care of the problem of sludge dumping off New York harbor.

13 Mr. Jordan. I think you will have a bunch of people leave
14 this meeting feeling that the millenium has arrived. Are there
15 any drawbacks?

16 Mr. Sheaffer. Certainly. The drawbacks you have to be
17 aware of are whenever you have kind of a transitional period in
18 how we do something, there is a lot of bitter battles. I have
19 battle scars all over me. And you are going to find it, too.

20 The arguments are that we ought to go the next round of
21 secondary treatment plants and then we will address this in 1978

22 Mr. Tozzi. I thought what he meant what were some of the
23 shortcomings, what are some of the arguments that people have
24 given us to say this doesn't work?

25 Mr. Sheaffer. The arguments are assembling a large tract

1 of land. I think the arguments come along the line of putting
2 the land together and seeing.

3 One nice thing is you can break it into a number of units.

4 Mr. Guard. Nobody wants that for a neighbor.

5 Mr. Sheaffer. That is it. You have to have the question
6 of the whole psychological question of New York's dumping on
7 me.

8 Senator Eagleton. But you said you could break it up with
9 a number of smaller units, but not with separate pipelines
10 pumping into each.

11 Mr. Sheaffer. I would see a major u-ban area going out
12 maybe four different routes, four different land areas, each
13 one would provide a site for a nuclear power plant and each one
14 would maybe have a hundred thousand acres in it. But I think the
15 problems are going to center around the land, around the neigh-
16 bors, around the whole psychological issue of status.

17 Mr. Jordan. What you are saying are social and political
18 problems and not technological problems?

19 Mr. Sheaffer. I don't think there are any technological
20 problems. The Chinese are saying this is the route they are
21 going to go.

22 I think this idea ought to be exported through our State
23 Department. We can't afford to throw nutrients away because of
24 the water pollution.

25 In places like Latin America and Africa they can't afford

to throw them away because of water pollution plus nutrients are scarce, and yet we are helping them built treatment plants which throw the nutrients into the water.

I think that should be stopped.

Mr. Brayman. You costed this out at \$24 billion. Is that the sewage just created by the population or is that industrial sewage as well?

Mr. Sheaffer. I did it on the basis of 150 gallons per capital per day and I assumed that 205 million people were connected to sewage. So an average person does not use that much water, that is what you get by taking the total use of water in a city and dividing it by the population.

Mr. Brayman. So that does include the industrial wastes?

Mr. Sheaffer. Yes, it would include water that is used for cooling, but I think that is a good estimate of the waste flow that we have to address in the country.

Mr. Tozzi. The other side of the question would be to ask for an estimate, which I think we have, of how much it would cost to get the same level of treatment using another technology like advanced waste treatment, because those are extremely expensive systems also. These studies that are coming out in the next months will compare these five cities, the costs of these different alternatives with this.

Senator Eagleton. Professor, we certainly enjoyed your presentation. It is very, very interesting and whether it will

1 be the millenium, to use somebody else's words over there, we
2 don't know yet, but that is not to ignore the political prob-
3 lems, especially if you are going to cross state boundaries. It
4 is going to be hard to sell state X on being the dumping ground
5 of state B.

6 Mr. Sheaffer. When they see what is coming, nobody minds
7 being dumped on when it is fertilizer worth a half billion
8 dollars.

9 Senator Eagleton. Have you given any thought to the ques-
10 tion of Federal financing of this in terms of Federal participa-
11 tion? In other words, 50 percent, 75 percent? Do we just pick
12 these figures out of the air or is there any wisdom to one or
13 another?

14 Mr. Sheaffer. I don't think I can add anything to what I
15 have heard discussed. Whether or not you want to make a crash
16 program and perhaps catch up to date and then let everything
17 be local from then on, I think, has a lot of merit to it. If
18 you want 90-10 or 80-20 and got systems of this nature or some
19 other nature all in place and then more or less turned operation
20 and maintenance and expansion back to units of local government,
21 I think this would make a lot of sense.

22 Mr. Jorling. I think there is a question of whether we
23 should encourage or discourage public usage of this.

24 Mr. Sheaffer. I don't like to see an industry with a pipe.
25 I think the Refuse Act permits should be as limited as practical.

1 When I approached Muskegon County, I said I didn't want any
2 industry to have a pipe because there is no way you can super-
3 vise that discharge unless you camp there Sundays, Saturdays,
4 around the clock.

5 Mr. Jorling. So you think it should be national policy?

6 Mr. Sheaffer. I think we ought to eliminate pipes if we
7 want to clean up the water.

8 Senator Eagleton. Professor, we have a series of questions
9 the staff has prepared and perhaps others we would very much
10 appreciate having the benefit of your advice so it can be made
11 part of the record. Could you help us on that?

12 Mr. Sheaffer. Yes, sir.

13 Senator Eagleton. We will recess now until 10 a.m.
14 tomorrow. Thank you very much, Professor.

15 (Whereupon, at 12:40 p.m. the subcommittee recessed, to
16 reconvene at 10 a.m. of the following day, Tuesday, July 27,
17 1971.)
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